

Title	Secondary School Elementary Mathematics Geometry Materials Series
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Date	27/07/2024

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Basic Guideline to Geometry in Secondary School

After finishing primary education and finally entering secondary education, you will be required to do a lot of things during Geometry classes including

- Reasoning with geometry
- Execute tasks which require geometry skills and knowledge
- Proving using geometric reasoning

If you are wondering what is the purpose of studying geometry, the study of geometry is vital to understanding how shapes, angles and direction are interlinked, which is crucial for the following fields

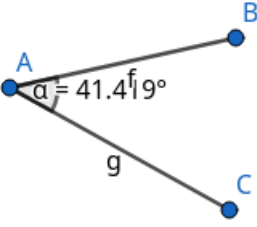
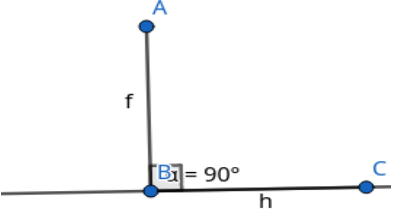
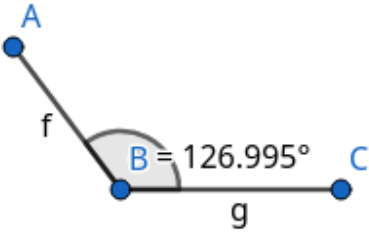
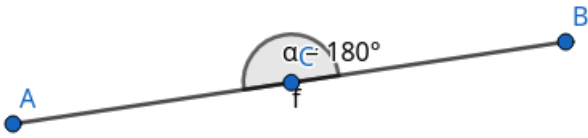
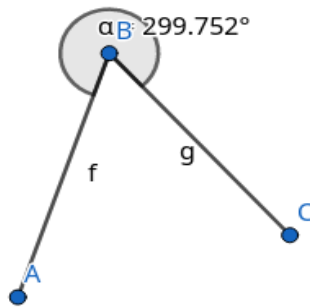
- Physics and Engineering – Where a solid understanding of geometry affects how stable structures should be and will be constructed
- Design – Where a solid understanding of geometry affects how simulations and how animation is constructed
- Higher Level Mathematics – Where a solid understanding of geometric principles affects how a person should view higher level Mathematics

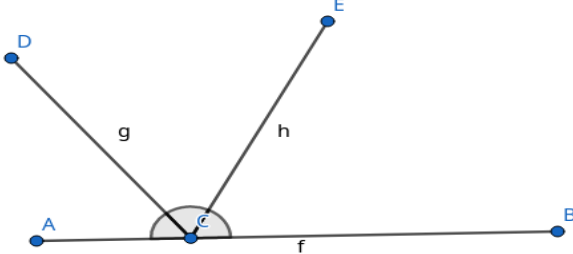
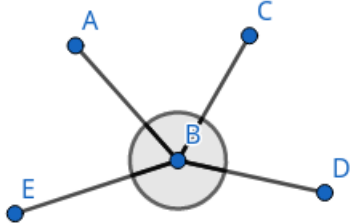
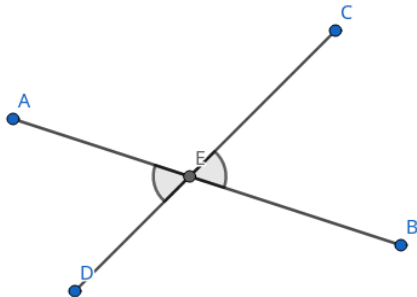
When you are working on geometry, you should remember the following rules

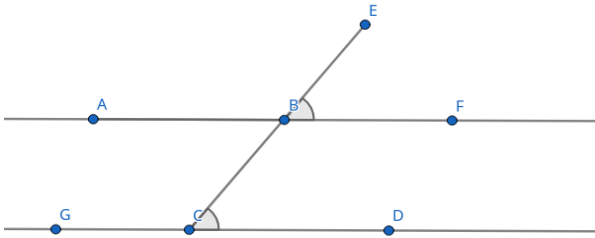
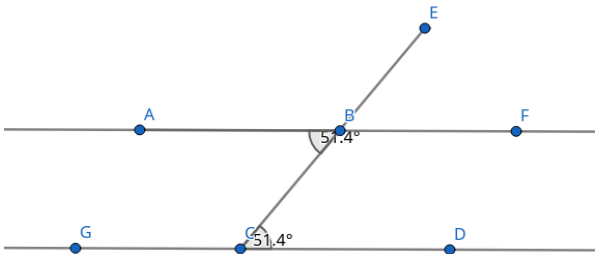
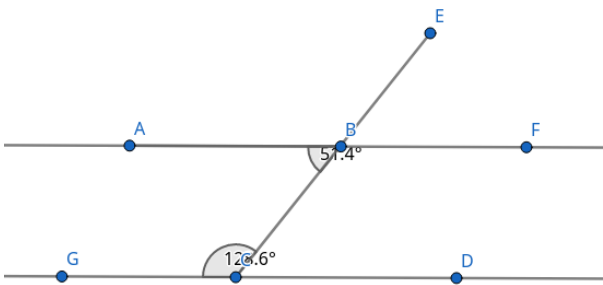
- Read the question or task carefully and meticulously – as misreading a geometry question might lead to erroneous application of geometric principles
- If the diagram is very complicated, try breaking the diagram down into smaller manageable units – I have seen certain geometric diagrams during my schooling years and I understand how complicated geometric diagrams can get
- Don't make assumptions – make sure your geometric logic is backed up by solid geometric principles rather than your own gut intuition

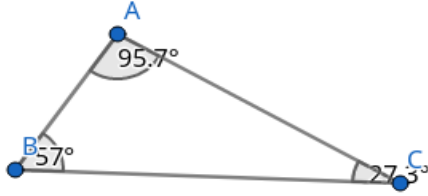
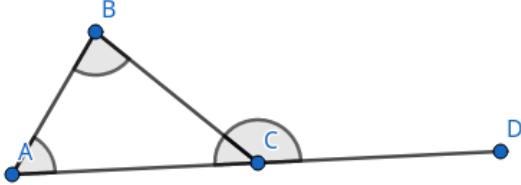
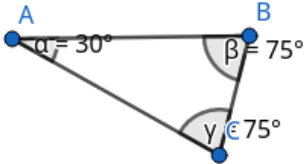
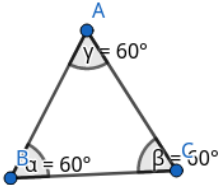
Notation

- $\angle$ means angle
- $\parallel$ means “is parallel to”

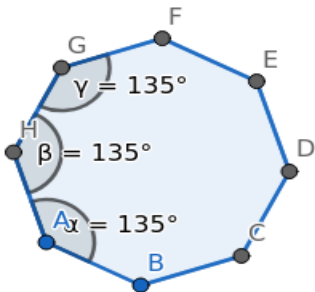
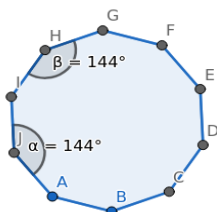
Type of Angle	Example or Illustration
Acute Angle Any angle less than 90° is an acute angle.	
Right Angle Any angle at exactly 90° is a right angle	
Obtuse Angle Any angle at between 90° to 180° is an obtuse angle	
Straight Angle Any angle at exactly 180° is a straight angle	
Reflex Angle Any angle at between 180° to 360° is a reflex angle	

Angle Properties	Example or Illustration
Adjacent Angle on a Straight Line (Adj. $\angle$s on a Straight Line)	 Explanation: $\angle ACD + \angle DCE + \angle ECB = 180^\circ$ if line ACB is a straight line
Angles at a point sum up to 360° ($\angle$s at a point)	 Explanation: $\angle ABC + \angle CBD + \angle DBE + \angle ABE = 360^\circ$
Vertically opposite Angle are equal (Vert. Opp. $\angle$s)	 Explanation: $\angle AED = \angle BEC$ and $\angle AEC = \angle BED$ if CED and AEB are straight lines

Angle Properties	Example or Illustration
Corresponding angles are equal, given parallel lines, AF and GD intersected by a transversal line	 $\angle EBF = \angle BCD$ (Corr. $\angle s$, $AF \parallel GD$)
Alternate angles are equal, given parallel lines, AF and GD intersected by a transversal line	 $\angle ABC = \angle DCB$ (Alt. $\angle s$, $AF \parallel GD$)
Interior angles sum up to 180° , given parallel lines, AF and GD intersected by a transversal line	 $\angle ABC + \angle BCG = 180^\circ$ (int $\angle s$, $AF \parallel GD$)

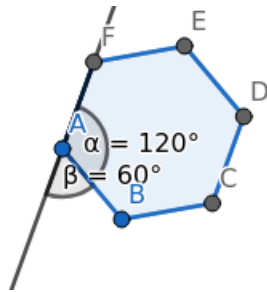
Triangle Properties	Example or Illustration
Angles within a triangle will always sum up to 180°	 $\angle CAB + \angle ABC + \angle BCA = 180^\circ$ ($\angle$ sum of triangle)
Exterior angle in a triangle equals to sum of the interior opposite angles.	 $\angle CAB + \angle ABC = \angle BCD$ (Ext. $\angle$ of triangle)
Property of isosceles triangle: 2 of the 3 sides are exactly the same length therefore: 2 out of 3 angles in the triangle has the exact same value	 $\angle ABC = \angle BCA$ as $AB = AC$ (Base $\angle$ of Isosceles triangle)
Property of equilateral triangles: all 3 sides are exactly the same length, therefore all 3 angles are 60° , as $180^\circ \div 3 = 60^\circ$	 $\angle ABC = \angle BAC = \angle BCA = 60^\circ$ ($\angle$s in equilateral triangle)

Number of Sides in Polygon	Naming of Polygon
3	Triangle
4	Quadrilateral
5	Pentagon
6	Hexagon
7	Heptagon
8	Octagon
9	Nonagon
10	Decagon

Properties of Polygon	Example and Illustration
For <u>any</u> polygon, sum of interior angle in polygon adds up to $(n - 2) \times 180^\circ$ Where n refers to the number of sides of the polygon	 In the case of what we see above, the regular polygon above is 8 sided, so, we can find the sum of all interior angle which works out to be: $(n - 2) \times 180^\circ = (8 - 2) \times 180^\circ = 1080^\circ$
For any regular n-sided polygon, each angle is computed as follows: $\frac{(n - 2) \times 180^\circ}{n}$ Where n refers to the number of sides of the polygon	 In the above case, we have a regular polygon that is 10-sided, so, each interior angle works out to be the following: $\frac{(n - 2) \times 180^\circ}{10} = \frac{1440}{10} = 144^\circ$

For **any** polygon, sum of exterior angle will always be 360°

For any **n-sided regular** polygon, each exterior angle will always have a size of $\frac{360^\circ}{n}$



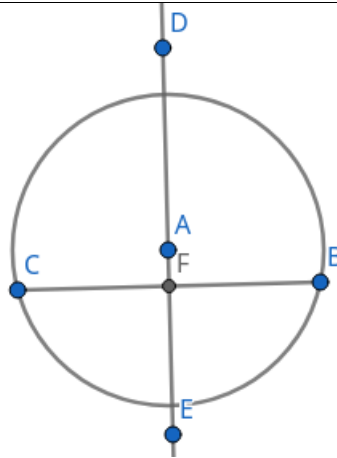
Exterior angle of any polygon is computed as follows
 $180^\circ - \text{Interior Angle} = \text{Exterior Angle}$

Since the above is a regular 6-gon (also called a hexagon), the exterior angle is also found by $\frac{360^\circ}{6} = 60^\circ$

Similarly, it is also definitely possible to find the number of sides of a **regular** n -sided polygon using the following formula, given the size of the exterior angle of a side

$$\frac{360^\circ}{\text{Exterior Angle}} = n$$

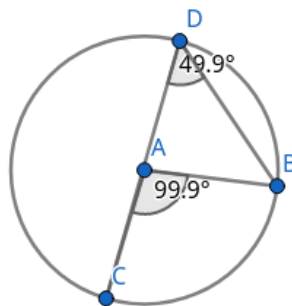
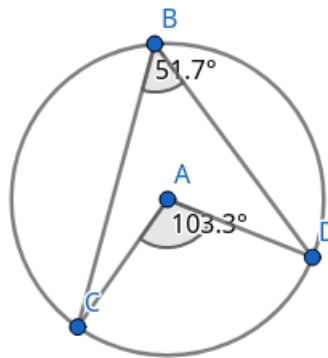
Properties of Circle	Example and Illustration
Equal Chord Equidistant from Centre of Circle	Given 2 Equal Chords designated AC and EG as in the diagram above, length $BD = \text{length } FD$.
Perpendicular Bisector of Chord Passes through the Centre of Circle	Given that Line DE bisects chord BC, DE will pass through point A as well, the center of the circle.



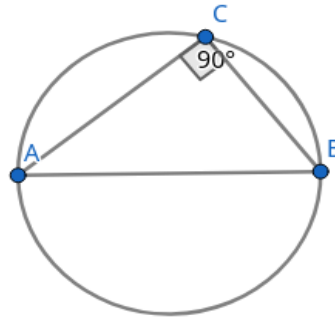
Given line DE bisects line BC ,
 Line $CF = \text{Line } FB$
 $\angle AFB = \angle AFC = 90^\circ$

$\angle$ at center = 2 $\angle$ at circumference

(Note: Some text call this mathematical fact inscribed angle theorem)



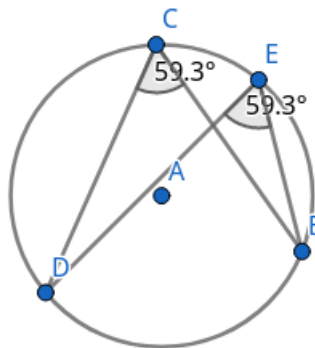
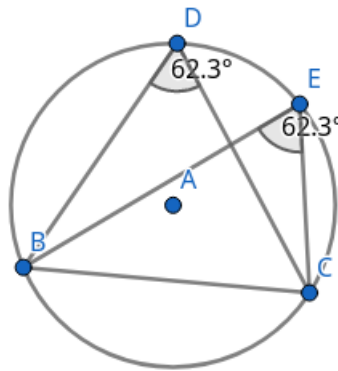
Angle in Semicircle



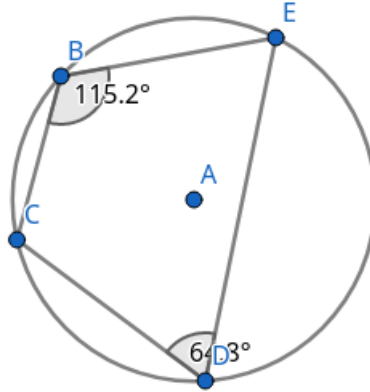
Given the straight-line AB which passes through the center of the circle, the angle $\angle ACB = 90^\circ$

(A special case of $\angle$ at center = $2 \angle$ at circumference)

Angles in same segment are equal



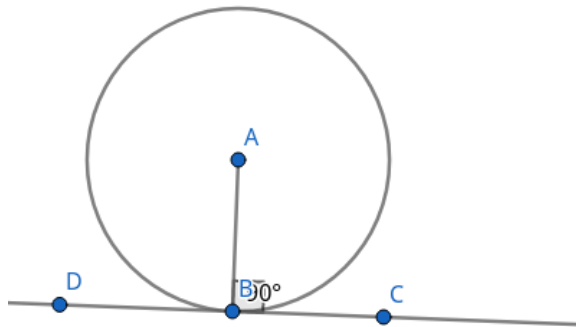
Angles in Opposite
Segments sums up to 180°



$$\angle EBC + \angle CDE = 180^\circ$$

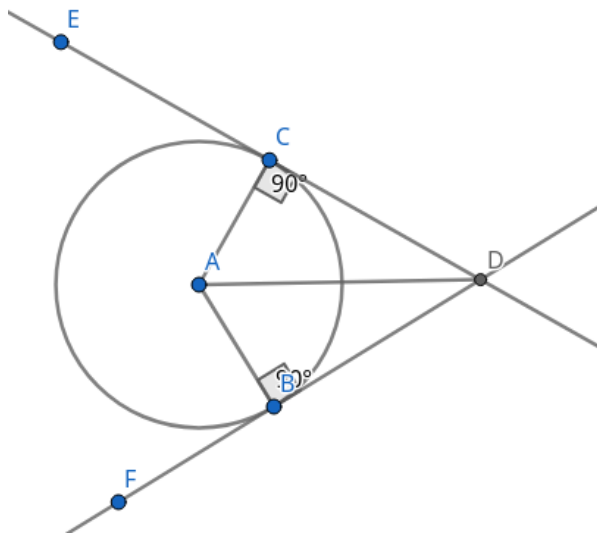
$$\angle BCD + \angle DEB = 180^\circ$$

Tangent to Circle
Perpendicular to Radius of
Circle



Given CD is a tangent to the circle, and AB is the radius
of the circle. $\angle ABC = \angle ABD = 90^\circ$

Tangent from External Point



Given CD and BD are tangents to the circle in the above diagram, $CD = BD$

$$\angle DAC = \angle DAB$$

$$\angle CDA = \angle BDA$$

(Tangents from External Point)